THE MODEL ENGINEER

Vol. 84 No. 2086

Percival Marshall & Co., Limited
Cordwallis Works, Maidenhead

May 1st, 1941

Smoke Rings

The Old and the New

I THINK it would be true to say that the micrometer has completely changed the work of both the machinist and the fitter, from what it used to be in older days. The introduction of improved types of lathes, and of milling, grinding, and other special machine tools has largely contributed to this so far as the detail work is concerned, but two other important general influences have been at work. Firstly, there has been the vast improvement in the methods of workshop measurement, and, secondly, the demand for mass production. The making of extremely accurate measurements is not really a new art, for did not Sir Joseph Whitworth, invent a machine many years ago, which measured to the millionth part of an inch? From a demonstration of the physical possibility of such a minute measurement has grown the now familiar micrometer in its various forms, and the normal shop practice of working to a " thou," or a " ten-thou " as the case may require. Moreover, there has been a remarkable development in the design and application of gauges of all kinds. The famous Johanssen slip gauges, the various types of limit gauges of the " go " and " not go " type, dial gauges and the use of accurately-sized strips and buttons have done much to facilitate exact and interchangeable production, and to educate the worker to a better appreciation of what a definite size really means. The need for exact sizes in repetition work is, of course, illustrated by the variety of machinery in general use for which spare parts and replacements are required, often at a distance from the place of production. What would the motorist do, for example, if he could not rely on a spare part exactly fitting his car engine, if an urgent repair or replacement became necessary? What would our mechanised army or our air force do in similar circumstances? The certainty with which machines can be assembled in the workshop from a store of identical parts, and with which replacement of parts on engines and machines in service at home or abroad can be made from stock, can all be traced back to the influence of the micrometer in production, and, in turn, its influence on the design of machine tools, jigs and fixtures, and gauges. In the old days when engines and machines were made one at a time, each part was its own fit into another part, and, provided the parts fitted, it did not matter whether they were a " thou " or so over or under the specified size. That procedure has been eliminated in the case of all engines, or machines, or other articles now required in large quantities in this mechanical age. The influence of Sir Joseph Whitworth on accurate production was very great, and all the tools and machines produced by his firm bore a high reputation for their precision of fitting and measurement. I often think of a story which I heard in my apprenticeship days in the shops of Richard Hoe & Co., makers of newspaper printing machines. I may have told this story before, but it is worth repeating. This firm, of American origin, were anxious to introduce their printing presses into this country, and obtained an order from a leading newspaper on condition that the machine was built in this country. Not having, at that time, any works of their own in England, they placed the order with the best machinists they could find over here, the firm of Joseph Whitworth. The press was built from drawings supplied, and duly installed at the newspaper office. On the trial run it was found that the shafts and rollers ran too stiffly in their bearings. The makers were asked to ease the bearings " a shade." They replied " We don't work to 'shades.' Tell us how many thousandths you would like taken off, and we will do it." That episode, to my mind, marked the turning of the tide between the old and the new methods of machine shop production, and just as Sir Joseph Whitworth standardised the screw threads of the engineering world, so his famous millionth measuring machine, and the beautiful machine tools, gauges and surface plates produced by his firm set a new note in workshop accuracy, the effect of which has been far-reaching, although his influence may have been largely forgotten, or may be unknown to the younger engineering generation. It is one of my pleasing recollections that I once had a Whitworth lathe on which to work. There are, of course, still many examples of engineering work where mass production methods do not apply, and where the individual skill and experience of the machinist comes into play to a much greater degree than it does with the automatic or semi-automatic machine tools, or with jigs and templates to assist him. There will always be room for the skilled turner and machinist for special work, but the science of exact measurement and its offspring, the micrometer, has had a remarkable influence on the possibilities of mass production and on the machine tools required for such work.

* * *

The Home Workshop as a General Shop

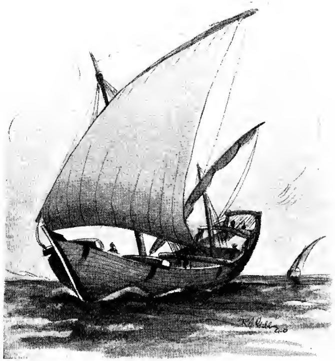
MY note on the influence of accurate measurement on mass production raises a thought on the position of the home workshop. Although the micrometer and a higher standard of exact measurement has become a feature of most home workshops, the work of the model engineer still approximates in character, if not in scale, to the work of the general engineering shop, where the methods of mass production do not apply. The building of large marine engines, locomotives, and pumping plants is usually a " one off " proposition, as is the case with special types of machinery and with repair work. Similarly in the model engineering workshop, only one engine or one model of a kind is usually built at a time, and each job has its own requirements as to fit and finish. The model engineer can rise to the occasion when a number of small details are required in duplicate or in quantity, and can add a capstan to his lathe, or devise jigs and fixtures for rapid production. But normally, his work proceeds on specialised lines, and each job provides its own production problems in setting and machining, and calls for its own application of ingenuity and experience.

Percival Marshall

Model of an
ARAB TRADER

By which, the novice—still dabbling—attempts to recapture in miniature some of the romance of the Immortal Dhow

By R. J. Gibbs



" . . . The prototype is a romantic vessel of some 50 ft. . . ."

I CHOSE a dhow for three reasons.

I wanted an ornament on my radio and I don't care for galleons; I had yet to see one outside a museum; and as a comparatively unwritten subject it presented an interesting problem.

I read all I could about them, which wasn't a great deal, and noted every picture I saw that showed a lateen sail. Not that a lateen sail necessarily provides a dhow: feluccas, dug-out canoes, and a host of others carry these beautiful burdens of sail-cloth and boom. . . .

The dhow, formerly used for slave-trading and piratical adventures (hence the long prow, built as a vantage point from which to throw stones at victimised craft), are now used for peacefully plying around the north-east corner of Africa.

They have been built for centuries at Aden, of teak, the shape and sizes of the material finally deciding the shape and size of the individual ships, hence the pleasing variations which provide laxities in building models. When building a liner you can't very well add side-boards just because you have a partiality for them. With a dhow you can, legitimately.

The type of vessel on which I finally based my drawings is comparatively small, being perhaps fifty feet long and used in and around the Red Sea for coastal trading and even shark-fishing. The raised poop (built to prevent "squatting" when running before a monsoon) is the only real vantage point for the crew, which sometimes numbers forty or more, the rest of the hull being used for the varied cargoes handled.

Most "museum pieces" are so obviously immobile that I decided mine must be sea-going. It is.

I built the hull from the drawings (to be reproduced in the next instalment of this article) on the bread and butter system. You'll need yellow pine, or perhaps deal, for this, and when the four breadth shapes are traced down, get the local joiner to run them around on his band-saw. Get as much of the interiors of the three top pieces removed in the same way, taking good care not to go too thin, as the boat has rather a squat, sudden bilge and requires good overlap of the laminations.

The glue I used was funny stuff. It's called "Casco." You make it with cold water, and it has the advantage of being really waterproof when hard. You get heaps for sixpence.

I didn't dowel my hull. By convention this is rather unforgiveable, but if Casco holds man-size gliders together in the air, I felt pretty sure the job I'd given it was fairly easy, so I took a chance. Nothing's come unput yet.

Shaping the outside is quite easy. Chisel off the steps as shown, and keep the mid-section drawing handy for negotiating the lower part of the bilge, as this is contained solely in the lowest board and, therefore, has no lines to work to beyond the centre line. Make a shallow saw-cut either side of the keel (Fig. 1) and work away from these with a small chisel. And now for a useful hint.

Smash an old glass negative by dropping it. The brittle nature of the glass invariably causes it to break in a fair curve that is most useful if handled as a painter uses a steel scraper. Follow the lines of the hull, working firmly but not too hard in the direction of the grain, as in photo. No. 1. By this method any "flats" and sudden changes of contour can be speedily and easily removed. All that should now show of the glued joints are lines of even thickness, or rather, thinness, and a light rub over with sandpaper brings you to the varnishing stage.

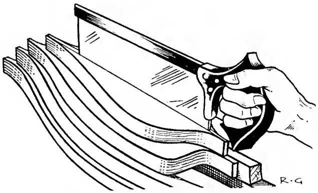
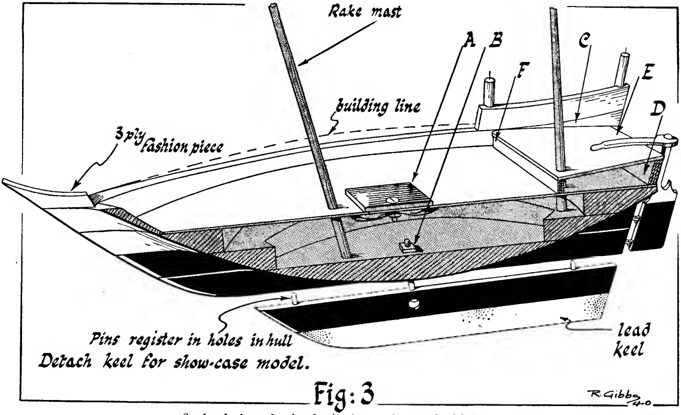


Fig. 1. Make a saw-cut either side of the keel.

A good idea is to paint up to the L.W.L. with Indian ink before varnishing. It soaks in a bit and gives a convincing "weathered" appearance.



Sectional view, showing laminations and method of ballasting.

The inside should be chiselled out, but in a boat of this size and type, so little weight would be saved by so doing, that I deemed it wiser to leave the larger joining surfaces for strength.

Thin down the bulwarks to the depth of the top joint and on the step so devised mount the deck.

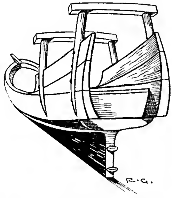
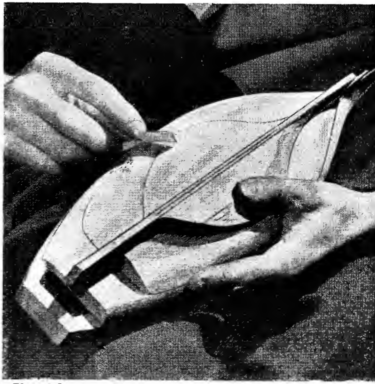


Fig. 2. Showing construction of poop.

I picked on a piece of 3/32-in. sycamore for this and, after painting the inside, I bedded it down on Casco and fixed with brass pins.

By the way, the hatch (*A*) is merely to facilitate the fitting of the keel (*B*) which slides upwards through a hole in the hull and is held inside with a nut, as shown in Fig. 3.

Now for cutting the sheer.



Photos by] [*Leon Isaacs*

Photo. No. 1. Showing the method of shaping with broken glass. Always work with the grain in long steady strokes.

Owing to the peculiarities of the bilge, the approved method of measuring off from the L.W.L. is rather unpractical, so I merely reversed the practice and measured down from the building line. It will be noticed that the sheer has to be built up under the poop and I suggest the additional pieces (*C*) are fashioned from the drawing and stuck on after to save straining the, as yet transomless, stern.

Building the Poop

The next move is to build the poop.

For the transom (*D*), pin a slip of 3-ply in the position shown after having chamfered the top edge to support the

Photo. No. 2. Notice how the scuppers sweep steeply aft.

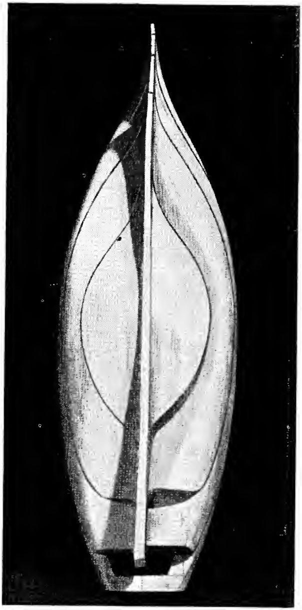


Photo. No. 3. Showing one side of the hull to shape, and the other side in steps, before carving.

upper deck (*E*). Cut this from the 3/32-in. stuff the main deck was made of and glue in position. An added support of plywood (*F*) can be fitted at the forward edge, similar to the transom. The pillars carrying the cross-beams—on which sun screens are stretched—are 3/16-in. dowel rod split up far enough to recess the additional plywood freeboard and then left round to the top. This sounds pretty complex, but if you refer to Fig. 2 you'll see it's quite simple.

The scuppers should be painted with Indian ink in imitation of holes and the edges made from 1/16-in. × $\frac{1}{8}$-in. balsa stringers pinned in place.

They'll bend both ways, so make them follow the sheer line and carry the top stringer out farther than the lower, as it carries the eye up steeply aft, and so adds to the appearance.

Take another look at photo. No. 2 and you'll see what I mean. . . .

Drilling Holes for Masts

In drilling the holes for the mast, care should be taken to keep the drill from leaning sideways. The main mast actually enters the hull at a forward slant and to my way of thinking imparts one of the quaint attractions that are so apparent in this rig. The aft mast enters at a much slighter slope or even dead upright. I chose upright, as it separates the two canvases and leads to less confusion when fully rigged.

(To be continued)

The Training of MUNITION WORKERS

By Percival Marshall, C.I.Mech.E.

THE need for a still greater flow of workers for the skilled and semi-skilled requirements of armament making is occupying the serious attention of the Ministry of Labour, and it has recently put forward some practical suggestions for the consideration of employers and those engaged in the training of newcomers to mechanical work. These suggestions are based on the realisation that a highly skilled mechanic cannot be trained in a few weeks, but that by analysing the degrees of skill required in the production of the various parts of a particular tool or component, the work can be parcelled out so that the most highly-skilled portions can be done by the most qualified men, and semi-skilled parts can be allocated to those workers with a lesser degree of handicraft ability. In the tool-room, for example, a first-class tool maker can do a job throughout, including any kind of turning, screwcutting, milling, grinding, or fitting which may be required for the tool or jig he is making. Some of these processes require a higher degree of skill and experience than others, and it is suggested that a semi-skilled worker or trainee could well be employed in the tool-room to relieve the skilled man from much of his less-exacting work.

The Ministry of Labour says: "There are several ways of making skilled labour go further. The secret of them all can be summed up in two maxims: (*a*) cut out all the unnecessary skilled operations; (*b*) never use the time of highly-skilled men on operations requiring less than their best level of performance. These principles of conservation can be applied to a greater degree than most employers have yet realised." There is, for example, a good deal of lathe-work to be done in the tool-room. A trainee, who has been taught metal-turning, or even a general turner, might be brought in to do this work, although he might not be fitted to undertake the all-round duties of a toolmaker. This applies equally to the processes of milling, grinding, and drilling, and in this way the time of the highly-skilled man could be devoted with advantage to the more exacting portions of the work, or to giving the finishing touches to the work previously roughed out for him.

It is a fact that hundreds of trainees from the Government Training Centres benefit by their training to an extent sufficient to enable them to pass direct into the tool-room of the factory to which they are appointed.

The same argument is applicable to tool-setting and operating on repetitive work. Here the tool-setting requires a higher degree of knowledge and skill than the mere operation of the machine, once the cutting-tools and stops are set. The skill and time of the setter should, therefore, be conserved for the actual work of tool-setting, and the operation of the machine should be allocated to a lower grade of labour specially trained for this work.

The Ministry gives the following hints for making the most efficient use of tool-setting ability:—

(*a*) Let your trainee setter have, not only blue prints to work to, but sample parts machined up to the completion of the stage through which the batch is to be put;

(*b*) Try as far as possible, to centralise grinding and maintenance of all cutting tools. This is specially important where setters are lacking in general experience;

(*c*) Supply operation-sheets which give details of the operations to be performed and their sequence. Equipment sheets should also be employed specifying the complete range of jigs, tools and gauges needed. Let a labourer draw tools and equipment from store and save the time of setters and operators.

On the question of improving output, the Ministry calls attention to the saving in man-hours which can be effected by the adjustment of workshop conditions to ensure the comfort of the employees. In particular, it says that proper ventilation, removal of eyestrain by improved lighting, and above all, the introduction of pleasant canteen facilities where well-prepared food is on sale, are matters of far greater importance for the promotion of higher output than many people imagine.

The training of women for munition work is another aspect of this problem, to which the Ministry is giving close attention. Experience shows that the proportion of women who only reach what may be described as the demi-semi-skilled level, is higher than in the case of men, but, even so, their work can be a most useful factor in the production output. There are, however, many women who are capable of reaching a good semi-skilled level, and every effort is made in the Training Centres to develop the natural ability they possess. It is well known, however, that some women possess unusual skill in work which requires meticulous

(*Continued on next page*)

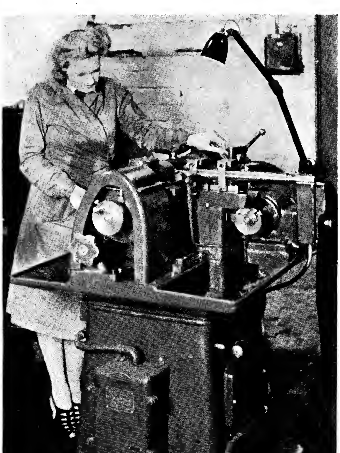


Photo. by] [*William Asquith Ltd.*

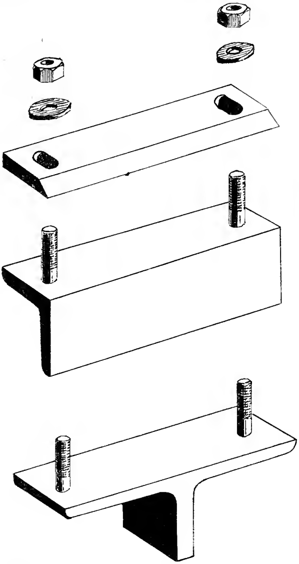
A trainee operating a splini ıg and slot milling machine.

A Bending Jig for Sheet Metal

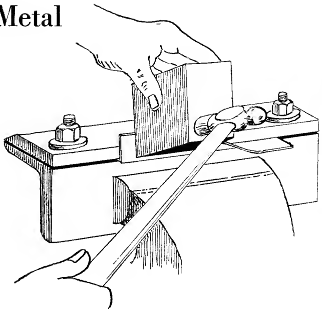
By L. A. Watson

I DO not claim any originality for this device, as I have seen something of the kind before ; but the idea may be new to some who occasionally have small parts to bend in sheet material. The jig I saw was about 9 in. long.

The sketches show the few parts required. The base may consist of a piece of angle iron or steel whose upper surface is filed or machined quite flat. (The bottom sketch shows an alternative form made from a piece of T section or H channel iron. If either of these are employed, the jig will be used at right-angles to the vice jaws.)



The component parts of the jig, with alternative form of base.



The jig in use.

The loose top bar is bevelled at about 45° along one of its long edges, this being useful in making sharp bends and in seaming laps. Note that the bolt holes are elongated into slots $\frac{3}{4}$ in. to 1 in. long. It is advisable to produce a slightly cambered or bowed lower surface on this bar (say 1/16 in.) as this ensures that the sheet metal to be bent will be firmly gripped all along its length. The studs or bolts may be about $\frac{3}{8}$ in. dia., and can consist of ordinary countersunk machine screws inserted from below and tightly driven home.

Bends should as far as possible be made upward rather than downward, as by this means the making of several bends is facilitated (e.g., four sides of a box) without the metal fouling the vice. Since the slots in the top bar are off centre, it can be slid backward or forward across the bottom bar on which a narrow ledge can be left exposed and along which it is easy to slide a small wood block while hammering up the bend. In my sketch I have, for the sake of clearness, shown the block being held slightly out of square with the front edges of the jig, but it should, of course, be held squarely for making a clean cut ri-ht-angle bend.

The Training of Munition Workers

(*Continued from page* 345)

accuracy and finish, or in the careful assembly and adjustment of delicate mechanisms and instruments.

Hundreds of model engineers have already found their way into munition work, either as instructors or trainees in the training centres, or in the factory. The demand for their interest and skill is as great as ever, and I hope that they will continue to come forward and make their contribution to the national effort. It can be very practical and very valuable.

*A CAPSTAN ATTACHMENT for Small Lathes

A device for the expeditious and accurate quantity production of small turned parts in the home workshop

By "Ned"

THE tool holder drawbolts, shown in Fig. 9, should be made and fitted before the tool holder sockets are drilled in the capstan head; this will enable the half-round notch to be formed *in situ* during the latter operation. They may be made from $\frac{3}{8}$-in. bright drawn mild steel, turned down and screwed $\frac{1}{4}$ in. B.S.F. at the end, and the holes which receive them should be reamered, preferably with a D-bit, so that they are a light drive fit. This will ensure that they remain in place while drilling the sockets; afterwards they may be eased a little with emery-cloth if desired, but this is not strictly necessary, and, in fact, there is no need to remove them at all when once fitted. If they are taken out, it will be advisable to mark them for identification, so that there is no doubt as to which holes they belong.

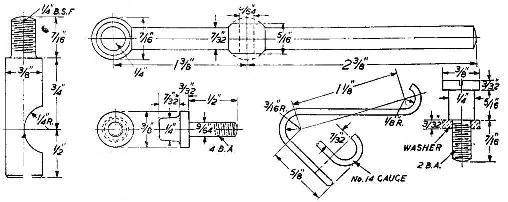


Fig. 9. Details of tool holder drawbolt (six off), unlocking lever, locking pin, spring and pivot screw (1 off each).

Unlocking Lever

There are several ways of making this component, and some readers may prefer a forging operation, but for those who have not the ability or facilities for this kind of work, a round section lever, which can be produced by turning as shown in Fig. 9, and subsequently bent to the required shape (see Fig. 1), can be recommended. The spherical portions of the lever should be formed as accurately as possible, so that when cross-drilled and spot-faced on either side, they will present a neat appearance. There will be no difficulty in bending the lever cold; its exact shape is not highly important so long as the locking pin points directly towards the centre when it is fully engaged. The reason why a bent lever is necessary is to ensure that the pin can engage the holes in the capstan head without any tendency to displace the latter. Some readers may consider that a plunger type of locking pin might have been better here, but while there is no objection to any constructor using his own discretion in the design of any of these details, it will be found that for ease of operation and simple construction, the pivoted lever has much to commend it.

The locking pin should be made either of tool-steel, hardened and tempered at the end, or of mild steel, case-hardened. It is screwed 4 B.A. at the tail, and the collar may be provided with flats to hold it while screwing up the nut. At the engaging end, it is tapered to an included angle of about 10 deg., and of such a size that it will enter about half-way into the holes in the capstan head, the point being carefully rounded off.

The pivot screw of the unlocking lever, which is also shown in Fig. 9, is a straightforward job, which calls for no special instructions, as it can be turned and screwed at one setting and parted off from a piece of $\frac{3}{8}$-in. mild steel rod. It will be seen that a special washer is required below the shoulder of this screw in order to pack the lever up to the required height, so that the pin is level with the holes in the capstan head.

A piece of spring-steel wire, 14-gauge or thereabouts (a spoke from an old motorcar wire-wheel is suitable) is bent approximately to the shape and dimensions shown in Fig. 9, to form the unlocking lever spring. It will be seen that the upturned end bears against the side of the lever, the middle bend then passing round the pivot washer and the tail being hooked around a stop screw set near the edge of the capstan slide plate.

Slide Operating Lever

This lever, and its connecting link, are shown in detail in Fig. 10. Both parts are made from rectangular mild steel bar, $\frac{3}{4}$ in. wide by $\frac{1}{4}$ in. thick, or the nearest available section. It may be mentioned that while the use of plain bars, with no attempt at improving their appearance beyond rounding

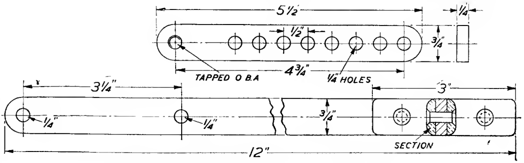


Fig. 10. Slide operating lever and link (1 off each).

* *Continued from page* 338, "*M.E.,*" *April* 24, 1941.

off the ends, may be objected to on the grounds of crudity of design, they will effect their intended purpose just as well as elaborately designed components, and are thus justified from the utility point of view. The pivot holes in these parts should be carefully reamered out to take the pivots, with the exception of the hole at one end of the link, which is tapped 0 B.A.

Some means of providing a comfortable grip must be furnished at the end of the lever. There are several ways of doing this, but one of the simplest is shown in the drawing, and consists of attaching pads of fibre, ebonite, hardwood, or metal, about 3/16 in. thick, on either side of the lever, and carefully rounding off all corners. The simplest way to attach the pads is by means of a couple of rivets, as shown, but if hardwood or a soft variety of fibre is used, it would be preferable to use special sunk bolts and nuts, similar to those used for securing the wood stock of a hand-saw. This form of grip is very comfortable to handle, but may be further improved in this respect, if desired, by slipping over it a 3-in. length of rubber tube, or a cycle handle-bar grip.

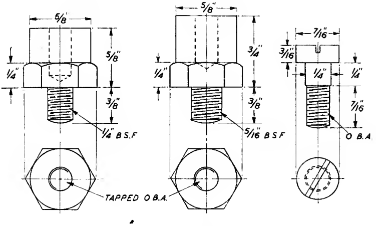


Fig. 11. Lever and link pivot posts (1 off each) and pivot screw (3 off).

Lever and Link Pivots

The lever and link are pivoted on special screws, the points of attachment on the capstan slide and rear cross-bar respectively being provided by "posts" screwed into the respective parts. Details of these posts and the pivot screws are shown in Fig. 11; the former may be made of any available material, but the diameter should be kept fairly large, in order to present a large bearing face on the surface. It is not entirely essential to make them from hexagonal bar, so long as some provision is made for screwing them home firmly. Although they have to be screwed home against the faces on which they are fitted, it has not been considered desirable to undercut the threads against the shoulder; a better method, in the present case, is to counterbore out the last thread or so in the tapped holes. The link pivot post is, of course, fitted to the tapped hole in the rear cross-bar, which also takes the gib clamping screw on the underside; the latter must therefore be shortened so that the two screw points do not foul, but if preferred, the post could be made with a screwed shank sufficiently long to pass through the bar and take a nut, thus dispensing with the need for a set-screw.

The pivot screws, three in number, are all alike, but while two of them are inserted in the tapped holes in the pivot posts, the third screws into the tapped hole in the link and is locked underneath with a nut. These screws should be closely fitted both in respect of diameter and length, so that slop and backlash of the operating gear is avoided.

Locating the Capstan Head

After fitting the lever and link, the slide can be operated "under its own power," so that it is now possible to mount up the capstan for drilling the tool-holder sockets. The slide should be attached to the lathe bed, the capstan head put on its post and lightly clamped with any one of its facets dead square with the lathe axis. In order to check up on this, the lathe faceplate should be mounted and ascertained to be running quite truly. A straightedge, consisting of a parallel bar about the same length as the diameter of the faceplate, is then clamped to the front facet of the capstan head by any convenient means. The capstan slide is now prevented from moving, by wedging a piece of wood between its rear end and the rear cross-bar (avoid driving this in so tightly as to strain or distort the slide), and the distance between the straightedge and the faceplate checked at the two extremities, by means of inside calipers or some other suitable form of gauge. After adjusting the head so that there is no perceptible parallel error, it should be clamped tightly, care being taken that it is not shifted in doing so.

The unlocking lever is then placed in its working position, with the pin engaging the appropriate hole in the head, and packed up by means of a strip of metal under the face of the end boss, and a thinner piece under the middle boss. Clamp the lever in position by means of a large tool-maker's clamp, or an improvised device of a similar nature, and "spot" the tapping hole for the pivot screw by means of a $\frac{1}{4}$-in. drill, which will, of course, have to pass through the packing piece in order to carry out this operation. Remove the lever, drill and tap the hole for the pivot screw, and fit the latter thereto. The unlocking lever, together with its washer and spring, may now be fitted, and if proper precautions have been taken, it will be found that the locking pin lines up perfectly with the hole. Although not shown on the drawings, a stop screw or peg, to prevent the lever being drawn back so far as to strain the spring, would be a useful addition.

In the event of any error having occurred in the location of the pivot hole, however, it is possible to correct it by making use of a longer pivot screw, passing through a slotted hole in the plate and equipped with a nut and washer underneath; or an eccentric pivot screw, passing through a plain hole, with a nut underneath, may be used. Another means of correction would be by completely re-machining the facets of the head, *in situ*, as will be referred to later. But none of these expedients should be necessary, if the work is carried out in the manner described.

Boring Tool-holder Sockets

The head may now be unclamped and rotated, when it should be found that the locking pin will engage with each of the holes in the head, and locate each facet in turn, exactly square with the lathe axis, the test with the parallel straightedge being repeated in each case. Again, accuracy should be automatic, if the head was indexed for machining the facets in the manner described last week; but in the event of error having crept in, through tackling the job by a different method, or for other reasons, it would be advisable to mount up the capstan head and slide plate on the cross-slide of the lathe, taking the utmost care in setting, to ensure that the slide ways are in true axial alignment with the bed, and re-facing each facet in its true location,

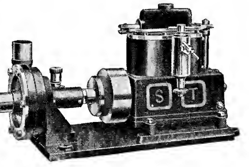
(Continued on next page)

Small POWER PUMPS

IN a recent article on "Improving Fire-Fighting Appliances," our contributor "Artificer" stressed the usefulness of small power pumps as a means of supplying water for replenishing local reservoirs on roofs or other remote conditions, and suggested that some of the small petrol engines constructed by model engineers are quite powerful enough to drive them. This view is confirmed by Messrs. Stuart Turner, who, as most of our readers are aware, manufacture several types of small petrol engines, and also a complete range of small centrifugal pumps, some of which are intended to be built integrally with fractional h.p. electric motors, and others suited for direct coupling or belt drive from any convenient source of power. In connection with this, they have sent us a table showing the performance of their Nos. 10, 11 and 12 pumps, which we reproduce herewith, and express the opinion that,

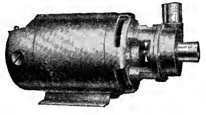
OUTPUT TABLES OF STUART PEDESTAL PUMPS.

	Head, In Feet	G.P.H.	R.P.M.
No. 10 ..	5	130	4,000
	10	100	,,
	5	100	3,500
	10	50	,,
	5	75	3,000
No. 11 ..	5	50	2,000
	5	180	2,500
	5	200	3,000
	10	300	,,
	5	350	3,500
	10	200	,,
	5	350	4,000
	10	300	,,
	15	200	,,
No. 12 ..	5	200	2,000
	5	350	2,500
	5	500	3,000
	10	250	,,
	5	600	3,500
	10	500	,,
	15	300	,,
	20	420	4,100



A Stuart centrifugal pump direct-coupled to a "Sirius" high-speed steam engine.

without the least doubt, any of these pumps could be driven by the Stuart "Lightweight" two-stroke engine of 30 c.c. They also append some useful details of the pumps in question, which incorporate a very ingenious patented gland, consisting of a carbon disc which is pressed against the sealing face of the rotor casing by means of a bell-



A Stuart motor pump unit, in which the centrifugal pump is built into the endplate of a fractional h.p. electric motor.

shaped rubber washer. Apart from the efficiency of this gland in preventing water leakage, it produces far less friction than the ordinary packed gland, and thus the pump requires far less power to drive, besides which it is immune from the rapid wear and scoring of the shaft frequently encountered with the ordinary types. In addition to their range of pumps which are supplied ready-made, attention is also called to those types which are available in the form of castings. The larger of these (No. 2) will deliver 180 gallons per hour at an included head of ten feet, when driven at a speed of 3,700 r.p.m., and is thus suitable for the purposes referred to.

Capstan Attachment

(Continued from page 348)

as determined by the locking pin in each case. This can be done by means of a face mill held in the chuck, the head being traversed across it by the cross-slide.

It may be remarked that meticulous accuracy of the facets is only of momentous importance when they are to be used for mounting tool-holders; it has no significance in the case of socket-mounted tools, and should the constructor decide to use a round capstan head, the question does not arise at all. But in a hexagonal capstan, it would be most slovenly to let the job go through with the facets out of square with the socket-holes, on the grounds of general workmanship. To the good craftsman, "right's right, and there is no such thing as 'near enough'!"—a much better policy than the ultra-modern one: "if you can get away with it, it's O.K.!"

The capstan head is traversed on its own slide for drilling the socket-holes, which should be started by means of a short stiff drill, such as a centre drill, and every care taken to avoid a tendency for the holes to run out of truth. After deeply centring, the drilling should be done in at least two stages, and very cautiously, so as to avoid any snatching, which might tend to shift the drawbolts. Finish the holes with a reamer or D-bit, the latter being preferable, as the slight taper or "lead" on the end of the ordinary reamer will prevent the production of correct parallelism in a blind hole. The drawings show the holes passing right through into the centre bore, but this is not possible when drilling them by this method, neither is it strictly necessary. A $\frac{3}{8}$-in. hole should, however, be put right through the capstan post to form a clearance for abnormally long pieces of work which may have to be turned by the attachment.

(To be continued)

Hints and Gadgets

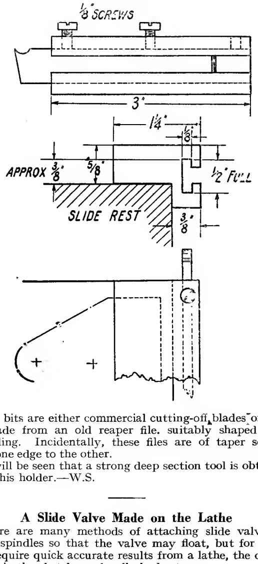
Short original and practical contributions to this page are invited from readers, and will be paid for. Address items to the Editor of THE MODEL ENGINEER, *and mark envelopes "Workshop Hints."*

How to Cut Rubber Easily

In cutting up old rubber inner tubes or other rubber articles, they should first be moistened with a solution of equal parts of water and glycerine. After this treatment, a knife or scissors will cut through any reasonable thickness without wavering from a straight line.—L. A. WATSON.

A Parting-tool Holder

This is made in mild steel, either from the solid or built up. The narrow slot may be found difficult to cut out of solid material, so a groove can be cut and retaining strips added on the face.



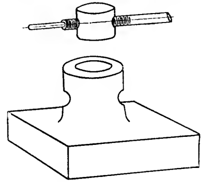
The bits are either commercial cutting-off blades or may be made from an old reaper file. suitably shaped after annealing. Incidentally, these files are of taper section from one edge to the other.

It will be seen that a strong deep section tool is obtained with this holder.—W.S.

A Slide Valve Made on the Lathe

There are many methods of attaching slide valves to valve spindles so that the valve may float, but for those who require quick accurate results from a lathe, the design shown in the sketch can hardly be beaten.

The boss on the valve should be turned first, and then the valve should be reversed with the boss gripped in a S.C. chuck. The working face may now be machined square with the boss, and the exhaust cavity recessed by turning. If the lathe is adapted for simple milling, erect the milling-head on the cross-slide, fit a change-wheel on the lathe spindle that will give a division of four, bring one edge of the valve horizontal and lock the change-wheel. Apply a small end-mill to the cavity to form two corners,



turn the valve through 180 deg. and repeat. Now form the edges which are to be at right-angles with the former.

The height of the valve should be slightly greater than the depth of the valve chest, so that the valve may be trapped beneath the cover whilst the hole for the valve spindle is drilled through the gland. Remove the valve and file the hole oval. Grip the boss in the lathe so as to reduce the height of the valve to ensure a working fit between the valve chest cover and the port face, after all the scraping has been done. I would add that if the lathe is in good trim, there is precious little of this.

If a ball is substituted for the cylindrical nut, perfect floating results, although the working face of the nut is reduced to a line.—D. A. WRANGHAM.

Cleaning Chromium-plated Models

By the frequent claims made for modern chromium plating, it might be imagined that chromium-plated model parts never require any cleaning. Chromium-plated models get dirty, and they will dull even by exposure to weather.

Experience shows the writer that the method of care or cleaning has a pronounced effect on the durability of chromium plating. Ordinary metal polishes or abrasive materials must not be used when cleaning chromium-plated models, as they are likely to wear through the chromium film. If cleaning is neglected entirely, the accumulation of dirt and dust absorbs certain vapours which accelerate the destruction of film of chromium. A good method to remove finger marks from chromium-plated models after much handling in warm weather, or when they have become badly dulled, is to use a clean soft rag or chamois moistened slightly with petrol. But as this method may be objectionable owing to fire hazards, it may be much better to use floated silica moistened with clean water. This treatment will quickly remove tarnish or blemishes from the plating and restore the chromium-plated model to its original brilliancy when a perfectly soft and dust-free chamois leather is used in the final cleaning.—A.J.T.E.

HOW TO CHOOSE A TECHNICAL BOOK

A talk which was broadcast on the B.B.C. Home Service, Tuesday, 4th March, 1941, 1.15-1.30 p.m.

By F. W. Rogers

MANY of us are coming face to face with a complete change of job. This week we have been going about our normal work of dictating letters, or taking them down; or running a home or errands; of serving lunches or selling programmes. Next week, or next month, perhaps, we shall be helping to make guns and shells and aeroplanes.

We can expect to feel a bit uncomfortable at first, and very, very ignorant. But we shall be keen to do our full whack as soon as we can; we shall become impatient of the time we have to spend in training. Perhaps we shall ask ourselves: "Why isn't there a book about this job, so that I can speed things up a bit in my spare time?" Assuming, of course, we have any spare time.

Right Book for You

Well, there are plenty of books—shoals of them—and some on nearly every kind of job. Good ones, a few awful ones, a sprinkling of indifferent ones; and we've got to make a choice. We can't just assume that the best technical book is the one with the dullest cover, the greatest number of mathematical symbols and the highest price. That one may be a very good book indeed—for somebody else. On the other hand it may be the clumsy, half-baked product of some author who is impertinent enough to tell others what he does not properly understand himself.

Of course I can't recommend you to buy Robinson's book on "Nuts and Bolts," published by White & Company and sold at Brown's bookshop. It wouldn't do, even if it were possible. But there are points about books that may help you to get value for your money and to save time and disappointment.

Publishers' names, for instance. These are useful because certain firms have a reputation for certain kinds of books. You can get their names and addresses easily enough from any of their books in your local library; or from newspaper and magazine advertisements. Of course, you'll only write to the firms who issue your kind of book. They will send you their lists for nothing, and your bookseller will either supply the book you finally choose from his stock, or get it for you as quickly as he can. By the way, please don't hog those lists that are no good to you. Remember that paper is precious and pass them on to someone else.

So much for the publisher, who produces the books; now for the people who write them.

The technical author, poor fellow, seems to have no glamour at all. No one cares whether he writes with a pencil or a pen, nobody bothers to photograph him with his pipe and his pet bloodhound in his country cottage. His news value is *nil*. He may have written only one book and that one may not have been of the kind to rouse interest and criticism. Because of all this, authors' names are unlikely to mean much to you, or to help you in your choice. But you might take this as a hint—a book telling you "how to do" a job (how to cut screws, or drill holes, operate planers, whatever it may happen to be) is best written by an expert in that job, not by an expert only at writing books. It's important that the book should be clearly written, but the technical author's main job is to provide the right material. An author who can say that he is a lecturer on his subject at a polytechnic, or that he has won prizes or certificates for practical work, has—well, put himself properly on the technical map.

Now, let's tear a book to bits and see what there is inside. Reading matter (or "text") illustrations, seven or nine preliminary pages—you know, those pages one turns over all at once to find where the book really begins—perhaps a few advertisements for other books, and the two covers.

Advertisements are like shop windows, and can be just as useful to you, but we'll skip those and turn to the often despised preliminaries, and first of all to the title page.

This is a right-hand page. It has the full title boldly printed on the top, and the publishers' name and sign at the bottom. Beneath the title are shown the author's name and qualifications. Very often, but not often enough, a sub-title is printed in smaller and lighter type, immediately below the main one. For example, the title "Pipes and Joints" might be followed by the words: "Plumbing for the Home Handy-man," and straight away you picture old Smythe-Jones doing his stuff under the kitchen sink. Another book with a very similar main title might be described as "A Complete Guide to Plumbing Practice, including Electrical Work, with tables of Melting Points." Much more business-like and professional in tone.

Even supposing you know as little as I do about plumbing (which is hard to believe), those sub-titles clearly tell you which book should help you most as a "potterer about" and which should help you to learn a new trade.

Curtain Raisers

Among the preliminary pages, and often on the left facing the title page, you may find an illustration. This is called the frontispiece. So far as we are concerned now, it is interesting but not very important. If it is only one of many illustrations scattered through the book, well—you are not going to judge the whole book by that one sample. If it is the only illustration, then obviously the book itself relies for its merits on the text, and the frontispiece will not affect your decision one way or the other.

Sometimes it is necessary to tell the reader, or possible reader, that the particular book is one of a series on the same class of subject; or that it is a better bound, or a less expensively bound, edition; or some other piece of information not necessarily the concern of the author. These details are often printed on a page by themselves under the heading "Publisher's Note." This note is important to you because it may suggest a better book than the one you have in your hand, or it may prevent you buying a book you already possess. The publisher's note may also try to tell you how good the book is; well—maybe you should form your own opinion about that.

The author has his particular say in the Preface. I used to loathe prefaces, especially when they were written to point out the moral of an otherwise jolly good story. But in a technical book the preface has this value: it tells you what the author has set out to do. A competent writer who knows his job should have the courage to give

himself away completely, leaving the world to judge whether or not he has fulfilled his declared aims. And a preface like that is very nearly a guarantee of good value, because unless the author is quite shameless he must have done his level best in the book itself. Besides this, if an author states among other things that "this little volume"—authors love that expression—that "this little volume attempts to cover the groundwork of soldering from first principles" you can form a shrewd idea of its probable value to you as a new beginner. A book said to be written "particularly for the craftsman who wishes to specialise in instrument repair work" may be more up your street if you happen to be an experienced tinsmith. And by reading two prefaces you may have saved yourself two shillings, or even two guineas.

But you don't buy the book yet. You still have to make sure that your author has really done what he has set out to do. Turn to the Contents page, where the chapter headings are set out against the page numbers on which they begin. If you are lucky, you will find beneath each heading a number of sub-headings. The result is a clear picture of the whole book, a much clearer and sharper picture than you would see by reading parts of the text at random. Notice how the book develops. Tidily, from a broad outline in Chapter 1, or the introduction, through each main division of the subject in turn, down to the details. I know it sounds "set" and dry and deadly dull, but think of the wear and tear on your brain if you have to jump about "all over the place" from particular to general and back again because an author or publisher has neglected his job. After all, you don't clean a car by washing, drying and polishing one square foot at a time; you complete one operation at a time because it's quicker, more thorough and less tiresome.

Just now I mentioned the introduction to a book. There are two kinds of introduction, the unnecessary and the useful. The unnecessary one is a collection of rather woolly thoughts by means of which an author finds his feet, or gets down to it, so to speak; this should have been heavily censored by the publisher. The useful introduction surveys the ground to be covered, and outlines the plan of the book. As the preface tells you the author's intentions, the introduction tells you his method of carrying them out. For example, the writer of a small handbook on drilling machines will frankly admit that he has no room to discuss every make that exists. But in his introduction, he may mention the different kinds by name for the sake of completeness, so clearing the ground for the development of the book proper. He may then tell you (all this in his introduction) that he intends to describe certain parts common to all drilling machines, and that these can be grouped into three types, A, B, and C. And if you were interested only in a very new class—D—that introduction would have saved you buying the wrong book. "According to taste," as they say on the Kitchen Front, an author may write all this under the heading "introduction" or include it in a rather swollen preface, or he may make it actually his first chapter.

Illustrations

Few practical subjects can be described clearly without illustrations. Photographs are more interesting than drawings, and modern close-ups of detail can be very helpful; but generally, lettered and dimensioned drawings convey more information. Absolute beginners sometimes make the mistake of trying to swallow an engineering drawing in one gulp. A drawing contains lines to represent the shapes of solid parts, lines to indicate hidden parts, lines to indicate the kind of material used and more lines to show measurements. Give yourself time to take in the essentials before you reject a drawing as being too complicated to understand.

You must expect illustrations to be on the small side these days because we have to go carefully with our paper. Drawings can, however, be clear, and photographs clear enough to serve their purpose, even if the photographic society would throw them out as works of art. Lines in drawings should be definite and sharp, lettering distinct, the whole drawing set squarely on the page. Illustrations should be near the text describing them, though it is not always possible to put them on the same page. Reference letters should be given on most illustrations so that details described in the text can be found quickly.

So, if you want to do the job thoroughly, write for the publisher's lists and make a friend of your bookseller.

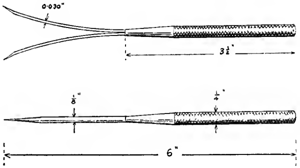
Take nothing for granted. Notice what, rather than who, the author is, and what other books he has written. Read the sub-title and preface, and glance down the chapter headings in the contents. Then flip over the pages and see if the illustrations are plain, and carefully drawn. Experiment on your own technical books, if you already have some, or on a few in the library. The buyer who knows what to look for gets the best value for his money.

So far as price is concerned I can only say this: find the right book and buy it, even if you have to drop cigarettes for a week. If you make a bad purchase you may have to go without cigarettes for three weeks in order to correct your mistake.

A Twin-point Transfer Scriber

THE sketch below shows a twin-point transfer scriber especially useful for transferring holes from die sections to the die shoe or bolster plate, from jig parts to assembly frames, and from machine parts to housings.

The handle or shank is made from a piece of $\frac{1}{4}$-in. diameter mild steel $3\frac{1}{2}$ in. long, tapered and knurled as shown. The tapered end is split down for $\frac{3}{8}$ in. to $\frac{1}{2}$ in. for the insertion of the soft spring-steel blades. The slot can be made by using two blades in the hacksaw frame. The spring blades should be about 0.030-in. thick (they are shown much thicker



in my sketch for the sake of clearness). Their width is $\frac{1}{8}$ in and length, $2\frac{1}{2}$ in. The scribing ends are tapered back for $\frac{3}{4}$ in. or so to form sharp points. The blunt ends may be silver-soldered into their slots, after which the tapered ends are slightly bent outwards, as shown, and hardened.

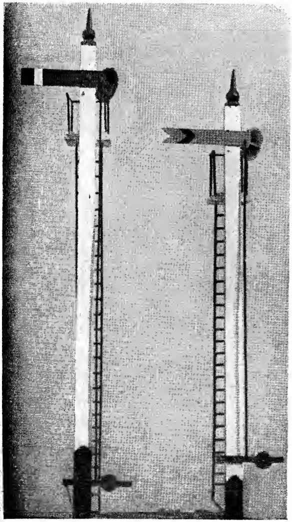
To use, squeeze the points together, insert in the hole, release the points and turn the tool carefully, exerting pressure in the same manner as when using dividers. Another method is to use a small tube $4\frac{1}{2}$ in. long, and which will just slip over the handle. Push down the tube until the points are inside it, drop the tube to the bottom of the hole, remove the tube and scribe as before. This is a better method for deep holes.—L. A. WATSON.

Modelling
RAILWAY SIGNALS

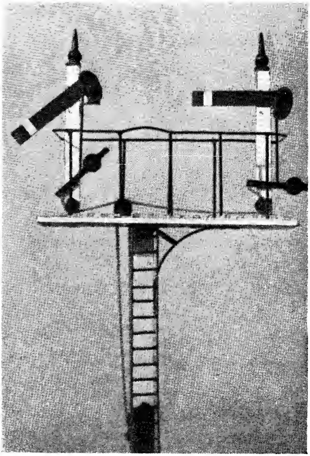
By R. Edwards

MY enthusiasm being fired by the articles in THE MODEL ENGINEER on "Railway Signals," by O. S. Nock, I decided to try my hand at modelling these, the results of which are illustrated herewith.

The signals are built to ½-in. scale, thus the overall height of the bracket arm signal is 13 in., the single arm signals being 15 in. and 13 in. respectively. The posts are made of square oak, planed to a slight taper, the decorative portion at the top being cast in solder, short length of brass tubing is pushed through the post as a bearing for the signal arm.



½-in. scale single-arm signals.



Double-arm bracket signal.

The signal arms are made of 20 gauge brass sheet, the spectacle plates being cut out with a fretsaw and fitted with pieces of appropriately coloured celuloid. These were cemented on with Durofix, and are intended for outdoor use.

Short lengths of ⅜-in. brass tube were parted-off to make the lamps, small circular discs of brass being soldered on the top and a small hole drilled for the aperture; the lamps were then soldered on to small brackets which were fixed to the posts with two tiny countersunk wood screws. These lamps are to be fitted with pea bulbs for night operation *after the war*.

The cross strips on the floor of the platform on the single signals are match sticks, while on the bracket-arm signal small strips of wood were planed up and screwed down with 90 tiny wood screws. The railings around the platform and the ladders are made from old bicycle spokes, these being cut from an old wheel, cleaned and bent to shape, then soldered together.

Balance arms and pulleys are cast in solder, wax patterns were cast up and a plaster of paris mould made in two halves, these were well sooted with a candle and quite smooth castings were the result.

The woodwork is painted white, while the railings, ladders, and the balance arms are black. The total cost of these signals was ninepence, this being the cost of a yard of fine chain.

*Improving the Two-Stroke

"VALVES for the VALVELESS!"

A discussion of the pros and cons of equipping two-stroke engines with valve-gearing

By Edgar T. Westbury

IT is by no means easy to build the house of the future with the bricks of the past, and many readers will say that it is not common-sense to try to do so, either. It may well be contended, however, that this is what I have been attempting in this series of articles; a careful analysis of them will reveal very little which can be claimed to be absolutely novel or original, and considerably more emphasis has been placed on the importance of carrying out the old ideas in a more workmanlike manner, than on the evolution of new ones. This mode of progress is not sufficiently rapid or spectacular for some of my gentle critics, who would like me to show them how to build something very far in advance of present design, and proportionately far ahead in performance. But although there is nothing I would like better than to be able to comply with their wishes, I would assure them that real progress calls for something more than brilliant ideas; it needs a considerable amount of practical experiment and test to develop even the smallest improvement, and if one attempts to go ahead without solid practical backing, the eventual result is likely to be disappointment rather than success.

As I took some pains to point out at the beginning of this series, there is a great temptation for me to "make a splash" with some sensational ideas in design, all of them very attractive, feasible, and scientifically sound—but untried. These would no doubt interest a small proportion of readers, but my object, in the present instance, is to provide directly useful information for a much wider circle of readers, by dealing with the more practical problems of design and construction as it is, rather than as I imagine it ought to be.

Up to the present, therefore, I have dealt almost exclusively with the form of two-stroke which is generally defined as "valveless," because that type is practically universal—at least in commercial practice—and it is also the only type about which any definite knowledge is available. The term "valveless" is, as previously pointed out, not strictly correct in a technical sense, but it is true in the sense that no special gear or mechanism is necessary for operating the valve events, beyond the main mechanical components which are regarded as necessary in any form of reciprocating engine.

The very earliest types of engines, including the original engine of Dugald Clerk, were, however, fitted with valves, and it is very doubtful whether Day, who is credited with the introduction of the first "valveless" engine, would ever have claimed more for it than that it simplified the mechanical design, and enabled the engine to be very cheaply produced. But in spite of its faults and limitations—and as we have observed, they are legion—the "valveless" engine soon became not only the predominant type, but practically the only one worth noting, at least in the smaller sizes. Apart from certain developments in large marine Diesel engines, nearly all of the many attempts to re-introduce separate valve-gears on two-stroke engines have been failures; if not technically, at least commercially.

The reasons for this have not been exclusively bound up with mechanical simplicity and low initial cost; there have been many instances where the application of most elaborate valve-gear has failed to improve in the smallest degree the *indicated* or internal horse-power of the engine, and in view of the fact that any form of valve-gear must necessarily take a certain amount of power to drive (in small engines, the power absorbed is usually considerable), it is evident that in such a case it would have been infinitely better to stick to the simple valveless engine. It does not follow, however,

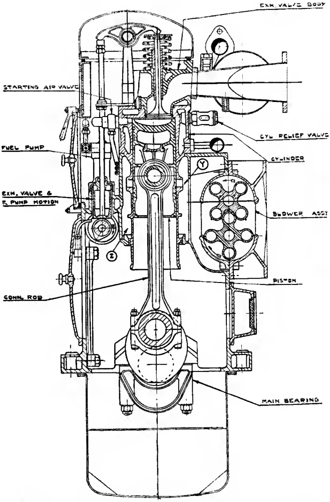


Fig. 57. A section of the Harland & Wolff (Burmeister & Wain System) oil engine, which is charged by means of a Roots blower and exhausts by means of a mechanically operated poppet valve.

that these instances, numerous as they have been, constitute conclusive proofs that improving the two-stroke engine by the application of valve-gear is necessarily and inevitably impracticable; the particular form of valve-gear or its method of application may have been inefficient, or its mechanical design may have been all wrong. From a careful study of some of the inventions which have been filed at the Patent Office during the last half a century, it is quite certain that such a state of affairs was by no means uncommon. Inventors, as a class, are rather prone to dive off

* *Continued from page* 319, "*M.E.*," *April* 17, 1941.

the deep end with a brilliant idea, without stopping to consider whether it constitutes a real and substantial improvement in principle, design or manufacture ; and the ultimate result is, all too often, bitter disillusionment. I must admit that I have often indulged in the pleasant, but generally profitless, pastime of building castles in the air—or even on paper ; but unlike the majority of the optimists whose mental offspring clutter up the Patent Office files, I have in most cases been sufficiently discreet to put my ideas to practical test before rushing off to pay large fees for the privilege of staking a claim to them. And even though I

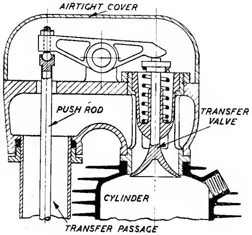


Fig. 58. An example of an overhead transfer poppet valve.

have evolved quite a few ideas which undoubtedly work my experiences in attempting to get them applied commercially have been very disappointing indeed. Incidentally, the two-stroke engine—a notorious happy hunting ground for inventors—is equally notorious in the commercial world as a means of wasting time and money ; and approaching a manufacturer with an idea for a new type of two-stroke is often about as dangerous as showing a red rag to a bull ! All of which goes to show that any idea for improving the two-stroke, which involves complicating it in any way, must be approached with the utmost caution, whether we are interested merely in improving the engine for its own sake, or have any ulterior motive in doing so.

In view of the known limitations of existing engines, however, there is quite a good reason for supposing that if we wish to develop their power output beyond a certain point, it will become absolutely necessary to introduce some form of valve-gear. This, incidentally, happens to be my own private belief, backed up by very extensive practical experiments ; but I also believe that it will call for an enormous amount of research work to develop the right type of valve and operating gear for the job. The adaptation of existing types of valve-gear is, in my opinion, extremely difficult, as nearly all of them have inherent limitations in respect of operating speed and port area, besides which they take far too much power to drive. It should be remembered that I am now referring particularly to those aspects of design which specifically apply to the development of very small engines, of specially high speed, as some of the above limitations are not so serious when applied to larger and slower-revving engines.

For the present, at least, I propose to maintain an attitude of caution towards the allurements of all the more ambitious schemes for equipping two-stroke engines with valves, as I do not think they come within the scope of the present series of articles ; but should it be found that there is a general interest in the subject, I may revert to it on another occasion. It is not, however, proposed to ignore the question altogether, and it will be of interest to take into account some of the simpler forms of valves which have been, or are being, employed in conjunction with model or small commercial engines, and to discuss their known or probable advantages.

It may be mentioned that most of the problems or disadvantages in the use of valves which are encountered in simple aspirated engines, are put in a different aspect when the engines are " blown " or supercharged. Apart from the reasonable contention that, in such circumstances, some form of valve-gear becomes necessary to ensure efficient timing and avoid wastage, it is possible to use higher gas speeds, so that valves of reasonable size may be used to deal with abnormal volumes of mixture or exhaust gases. But against this is the rather awkward fact that temperature problems may be more serious, especially when mechanically-operated exhaust valves are employed. There are, however, a number of successful examples of large blower-charged two-stroke engines with poppet exhaust valves, notably the Burmeister & Wain engine for locomotives and marine propulsion (Fig. 57), which is manufactured under licence by Messrs. Harland & Wolff, Ltd., Belfast. But supercharging is a subject which will have to be dealt with by itself, later on.

It is comparatively rare that any attempt is made to control all three of the functions—inlet, transfer and exhaust—by means of special valve-gear, and more often only one valve is used, with the object of improving the efficiency of the particular function which appears to the designer to be most in need of artificial assistance. The use of a valve to control exhaust is most unusual in small high-speed engines, mainly because the large area of

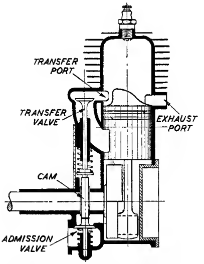


Fig. 59. An engine with poppet inlet and transfer valves, operated from a single cam.

this port, and the high temperature of the gases, make it extremely difficult to carry this out with *any* form of valve gear. It is, however, as I have said before, most illogical to shelve a problem because it is difficult, and I have every reason to believe that there is just as much, if not more, to be gained from selective timing in the case of the exhaust valve as that of the other—but here I am again, wandering from the solid ground of fact into the bog of conjecture. To return to our subject, let us consider the known types of valves, and their application to the problems which we are discussing.

Poppet Valves

This type of valve is so predominant in internal combustion engineering that it is naturally entitled to first consideration in the present instance. From the purely theoretical point of view, it is one of the worst conceivable types of valves, because it cannot, in its simple form, be pressure-balanced, it requires an abnormal amount of power to operate, and it cannot be relied upon to close positively, since its closure can only be effected in a reasonably simple manner by the use of a spring. In practice, however, it is remarkably successful, mainly because it is mechanically robust, and will stand up to a considerable amount of abuse without actual failure.

The particular conditions which exist in two-stroke engines, especially if they are small and run at high speed, render the application of poppet valves abnormally difficult, because of the extremely large port openings necessary, and the extremely short periods allowable for opening. Apart from the design of the valve itself to cope adequately with these conditions, the operating gear presents special problems, since the combination of high lift and maximum acceleration necessary in this case is a perfect nightmare to the cam designer. It is perfectly hopeless to approach such a problem without a special knowledge of the science of kinematics, or in other words, the dynamic effects of the acceleration or retardation of moving masses.

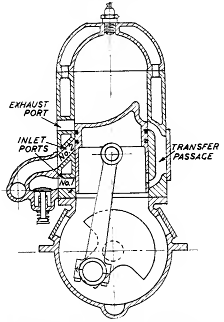


Fig. 60. Section of an early Gray marine engine, with combined port and automatic valve admission.

It is generally recognised that when a valve is used for controlling the transfer of the mixture, the best place to locate it is at the end of the cylinder remote from the exhaust ports, so that the scavenging air or mixture must traverse the entire length of the cylinder before it has a chance to escape to exhaust ; in this way the likelihood of mixture wastage, or of leaving excessive exhaust residue in the cylinder, is lessened. Fig. 58 shows an example of an overhead transfer valve which I employed in an experimental light aircraft engine of about 1½ litres capacity some years ago. It will be seen that the valve, which is located in a ported cage immediately in the centre of the cylinder head, is operated by means of a push rod and overhead rocker of quite an ordinary type, the entire gear being enclosed inside the transfer passage, thus avoiding difficulties in sealing the valve stem against leakage, and incidentally keeping the parts thoroughly lubricated. The arrangement provided for direct operation from a cam on the crankshaft ; but in actual fact, two cams per valve were employed, one of which was timed to open and close the valve at the times best suited for efficient full power operation. The second cam was purely for control of engine speed, which was effected by returning a greater or smaller proportion of mixture back to the crankcase during the early portion of the compression stroke.

This engine embodied several other unorthodox features, and thus, although it was moderately successful, it was never developed sufficiently to give it a fair chance of complete success ; the power-weight ratio was, however, distinctly high for light aircraft engines at the time. One of its limitations, which is common to all engines which employ an overhead transfer system in conjunction with crankcase compression, is due to the fact that the large volume of the long transfer passage prevents the crankcase pressure from being raised adequately to provide reasonably high volumetric efficiency at high speed.

In order to cope with the latter disadvantage, the transfer valve has occasionally been used in conjunction with a more normally situated transfer port and piston deflector system. The port is, however, timed to open much earlier than usual —before the exhaust port, in fact—but as the valve is closed when the port first opens, blowback down the passage is prevented. At the normal transfer port timing, the valve is opened, and remains open until after the closure of the port. By this means, the transfer period may be prolonged to almost any desired extent, allowing of much more efficient charging than the normal port system, and of preventing wastage from exhaust, so that supercharging may be employed.

As the valve is screened from the combustion flame, and does not have to close promptly on time, it works under the easiest possible conditions ; it does not, however, provide uniflow scavenging, or eliminate deflector problems. The arrangement has been used with advantage on large engines, though other types or valves have often been found more efficient mechanically than poppet valves, but such attempts as have been made so far to apply it to small high-speed engines do not appear to have yielded very conclusive results, and it is still in dispute as to whether the net gain in performance is sufficient to justify the extra complication.

Fig. 59 shows a diagrammatic representation of an engine fitted with a transfer valve of this type, and also an " inverted poppet " valve, both being operated from a single cam on the mainshaft. It should be noted that although the valves are shown, for purposes of illustration, diametrically opposed above and below the shaft, it is, in practice, necessary to set the inlet valve at an angle in order to ensure its efficient timing, relative to the piston stroke, by means of a single cam.

Regarding the merits of poppet inlet valves, it may be remarked that, about 20 years ago, there was a commercially produced motor-cycle with a two-stroke engine of 250 c.c. thus equipped, which could attain a speed of over 80 m.p.h. ; I am not quite certain what happened to it in later years, but there is some reason to believe that the firm went bankrupt through spending too much money on experimental work.

Automatic Poppet Valves

In discussing poppet valves, one is liable to forget the simplest and most primitive form of this valve, namely the light spring-loaded " soupape automatique," so much beloved by the early I.C. engine designers, and as wholeheartedly hated and despised by their modern successors. Automatic valves were used in several of the early two-stroke engines, their most common application being that

of an admission valve in place of the usual admission port.

An example of this type of valve is seen in Fig. 60, which depicts an early Gray marine engine, made in U.S.A. before the last war, which was "doubly blessed" (?) by being equipped with both an automatic admission valve and the more common (in modern practice) piston-controlled port. It is presumed that both are connected to a common intake manifold and carburettor, but this is not clear from such information as is now available; there is some reason to believe that the automatic valve was claimed to facilitate starting and slow running, and possibly the other port was throttled in these circumstances. While the use of such an automatic valve may not be tenable for full power running on a modern racing model two-stroke, it might be a useful addition for use in a similar capacity to that instanced above, on some engines which are known to be rather temperamental in starting up and getting away on load.

There have also been several instances of automatic transfer valves, examples of which may be quoted in at least one early motor-cycle and one stationary engine, both of which had the transfer valves in the head; while others employed them in conjunction with a more or less normally timed transfer port. Some again, effected considerable simplification of general engine construction by placing an automatic transfer valve in the head of the piston, as shown in Fig. 61. Superficially, at any rate, this scheme seems to offer some interesting possibilities, but in practice there were quite a few snags in it, one of the worst of which was due to the fact that it was almost impossible to make the valve sufficiently robust to stand up to its very hectic job, and at the same time to work efficiently. It may be remembered that the early rotary aero engines, which had inlet valves in the piston heads, were also prone to spots of bother in this department, and speaking from actual experience, I can assure you that the effects of a valve coming adrift and running about wild in the cylinder were pretty terrible, especially if one had the job of repairing the damage afterwards.

Several years ago a design for a stationary two-stroke engine, having a transfer valve of this type, was published in THE MODEL ENGINEER, and to judge from later correspondence from readers who constructed this engine, it appeared to be by no means immune from this kind of valve trouble. Attempts have been made to develop a means of mechanical operation for a valve situated in the piston, which would be quite useful if it could be done without undue complication, and so as to be completely reliable. Both, however, are very tall orders.

There is, however, a very interesting modern example of a piston-head transfer valve, applied to model practice, which I am told works quite successfully, and to which I shall refer in due course.

Although the spring-loaded, pressure-operated type of automatic valve eliminates the complication and mechanical loss involved by mechanically-operated valves, and is capable of giving quite satisfactory and reliable results within a limited range of performance, it has a natural throttling action on the mixture or gases at any speed, and is quite incapable of operating efficiently at really high speed, so that it is extremely doubtful whether it has any place in the design of modern engines of high speed and performance. In my experiments with the "Atom 1" engine, which was originally constructed as a two-port engine with an automatic admission valve (also constituting the carburettor), it was found that fair efficiency was obtained under load up to a speed of over 3,000 r.p.m.; but later experiments with an improved admission system not only enabled an increased power output at this speed, but also enabled much higher speed and power to be obtained. In the Dolphin engine, which was referred to early in this series of articles, a considerable amount of research work was done in developing the very ingenious automatic transfer valve, which was one of the special features of this engine; but in spite of these efforts, there is reason to believe that this valve seriously limited the efficiency of the engine.

Piston Valves

Strictly speaking, the common or garden two-stroke engine is a piston-valve engine, but there have been some examples of engines in which a separate piston valve, comparable with that of a steam engine, has been employed for controlling the transfer or admission ports, or in some cases, both. A piston valve, operated by an eccentric, has a smoother action than a poppet valve, and also cuts off positively at any speed, but if it is to be really effective against high pressure and temperature, it must be robustly constructed and very closely fitted, so that it increases the reciprocating weight, and also the running friction. It is probable that the amount of power absorbed by a piston valve at high speed is at least as great as that required to operate a poppet valve, while the sealing efficiency of the former type of valve is much inferior to that of the latter.

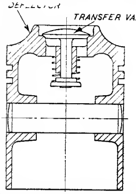


Fig. 61. An automatic transfer valve fitted to the piston head of a two-stroke engine.

Large Diesel engines are sometimes equipped with a piston valve in the transfer port, for the purpose of prolonging the transfer period, as described above. In this case the valve can be fairly light, and works under favourable conditions, so that the arrangement is quite satisfactory. The Record engine, which was made some years ago for stationary work, employed a piston valve which was employed as an extra power piston to transmit explosion thrust to the crankshaft. This arrangement approaches very closely to the principle of the double-piston engine, such as exemplified in the Lucas, Trojan and Zoller engines.

Sleeve Valves

The sleeve valve is actually nothing more or less than a hollow piston valve, working inside the cylinder bore, and constituting a liner in which the working piston operates. It is thus subject to much the same limitations as an ordinary piston valve, except that it can, and indeed must, be made quite light in construction; but even so, its weight is a serious disadvantage, besides which it has a very large friction surface area. As a result, good balance and mechanical efficiency are difficult to ensure, and lubrication problems, already rather acute on a highly-stressed engine, are liable to be increased.

Some two-stroke engines have been made with single-sleeve valves similar to the Burt & McCollum type, which seems to be established as the most satisfactory working principle at the present day. It would appear that sleeve valves are far better suited for use in engines having large-bore cylinders than very small ones, and also for moderate rates of speed rather than high r.p.m. Many years ago I built a three-cylinder sleeve valve engine which ran quite nicely, though not so efficiently as I had hoped it would; but the fatal snag about it was that the mechanism which operated the sleeves, although worked out entirely independently, was found to be an infringement of several prior patents.

(To be continued)

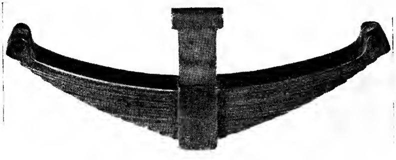
Letters

A Stroudley Model

Dear Sir,—I thought, probably, the illustration and particulars given below would be of interest to certain readers who belong to the model locomotive fraternity, for it seems evident that the above-named celebrated Loco. Engineer, of whom mention has often been made in the pages of The Model Engineer, had an appreciation of the model-makers' craft. The locomotive historians have recorded certain engines that were under construction, or on order at Brighton works at the time of the lamented decease of Wm. Stroudley, but there was one engine that, so far, has received no public mention.

This was to have been a very fine, large scale model of one of the famous "Gladstone" class of 0-4-2 express passenger engines.

The writer heard of the model during his days as a premium apprentice at the Brighton works under Robt. Billinton and Douglas Earle Marsh, and was privileged to see certain of the parts which had been made, and stored away. He also contacted certain gentlemen who then were occupying official positions in the works, but who, in their apprenticeship days, under Stroudley, had been engaged on the construction of the model.



A model of a standard "Gladstone" class leading axle spring.

For what exact purpose the engine was being made, no one seemed to know, but there was a keen recollection of Stroudley's interest in the model, and his insistence on it being a perfect representation in model form, of his locomotive masterpiece. The work on the model was stopped soon after Stroudley's death in December, 1889, and the parts already made were kept in the old Turnery (as the main machine shop was called) Tool Stores loft.

After a time, however, various work's officials claimed parts of the model as "Stroudley souvenirs," and so the pieces gradually disappeared.

The part now illustrated, a leading axle spring, came into the writer's possession many years ago, having been presented by one of the officials above referred to, a short time before his decease.

The spring is a faithful representation of the standard "Gladstone" class leading spring, and is beautifully made. The centres of the spring-pin holes of the top plate measure $5\frac{1}{8}$ in., the corresponding prototype dimension having been about 3 ft. 6 in.

It is a tragedy that the model was never completed, for it would have been a most valuable acquisition to such an institution as the South Kensington Museum, or it might have served the L.B. & S.C. Railway Company well in publicity work, as a grand show-piece, suitably housed in a glass case at one of the Company's large terminal stations.

The work on the model was mainly executed by certain selected apprentices, under conditions of strict privacy. That such an eminent engineer as Wm. Stroudley thus showed his regard for model work, should afford much satisfaction to model engineers generally, and help them into a realisation of the dignity and importance of their craft.

Yours faithfully,

Liverpool. Wm. E. Briggs.

Fitting Ball-Races

Dear Sir,—With reference to my letter quoted by Mr. Westbury in his article on p. 275 in The Model Engineer of April 3rd, I note that the interference quoted for the Type S3 bearing is given as 0.003 in. This should, of course, be 0.0003 in. An interference of this order on such a light bearing, even supposing that it were not split in assembling, would certainly ensure that the balls went round with a tuneful click. My subconscious memory tells me that I gave this as .0003 in., without a cipher in front of the decimal point, and it is possible that the compositor lined it up with the other two by moving the decimal point.

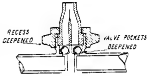
Yours faithfully,

Sale. O. B. Bates.

Pump Troubles

Dear Sir,—I was very interested in the "Feed Pump Problem" in the March 20th issue of The Model Engineer. It seems to be, that on the delivery stroke of one pump, sufficient turbulence is set up to disturb on its seating, the outlet valve of the opposite pump, thus allowing part of the delivered water to escape alternately into each of the pump barrels instead of being delivered up the outlet pipe. The fact that one pump delivers as the other raises water, helps this action.

Suggested arrangement of outlet valves to prevent turbulence.



To prevent this turbulence the outlet valves should be placed at points below the junction of the two pump deliveries with the common outlet. (In the drawing of the existing pump the valves are at the junction of the two deliveries.)

For the sake of clearness I give a sketch of one way of preventing turbulence in this particular pump. Trusting this will be of some use to your readers, and hoping that *Tich III* will soon do the knots around the line.

Yours faithfully,

Bournemouth. A. C. Kerley.

Motor Troubles

Dear Sir,—In reply to Mr. H. Howard Freeman's letter on some helpful criticism of my article entitled "Troubles with a Motor," I would like to say that I thought that I had made it quite clear that this motor was only intended to be run for very short periods and to this end was only used for driving a small grinding-head, and that I did not wish to convey any other impression.

Secondly, that the bowl-fire element, far from being inadequate, has run the motor and has given no trouble

for approximately two years, but, of course, never for longer than five or ten minutes. at a time

With reference to Mr. Freeman's statement that, " The only satisfactory method of running a 110 V motor from a 220/30 V supply is by using an ordinary sliding resistance, etc." Surely a transformer would be a much better alternative and would require no attention or adjustment whatever.

Yours sincerely,

Liverpool. WM. CLEGHORN.

Clubs

The Society of Model and Experimental Engineers

There was an exceptionally large attendance at the Meeting held at the Caxton Hall on Saturday, April 5th last, and the accommodation provided proved to be inadequate. Mr. H. L. Pinches, of Leatherhead, and Mr. T. G. Taylor, of Woodford Green, were elected members. Mr. R. D. Steele (Southern Railway, Bournemouth), delivered a lecture entitled "Diesel Rail Traction." He first considered the inducements which led the engine builder to undertake costly experiments in a field where the steam locomotive already held an established reputation, and showed slides of the Sulzer Diesel locomotive of 1913, and the Mayer Geiger locomotive of 1930, followed by modern examples of British and Colonial Diesel locomotives. The lecturer then described very fully each of the components which constituted a Diesel traction unit, and dealt with the engine, fuel injection arrangements, methods of starting, cooling, and lubrication, and the design of frames, bodies, and transmission systems. In conclusion, he reviewed the economic factors which determine whether or not Diesel services are justified.

A Vote of Thanks to the lecturer was proposed by Mr. J. C. Crebbin, seconded by Mr. A. W. Marshall. Among the visitors were Mr. Pelham Maitland (Nine Elms), Mr. H. Nicholson (Norwood Junction) and Mr. J. Howard (Bricklayers' Arms), Mr. Edgar T. Westbury and Mr. J. P. Ripper.

An experimental internal combustion loco. chassis was exhibited by Mr. Westbury and Mr. Ripper.

To-night, Thursday, 1st May, in the Workshop, 20, Nassau Street, London, W., at 7, a Stationary Engine Meeting will be held. The Society's gas-fired water tube boiler will be available for the running of models under steam. Visitors are cordially invited. Full particulars of the Society may be obtained on application to the Secretary.

Sec.: H. V. STEELE, 14, Ross Road, London, S.E.25.

The Harrow Model Engineering Society

Until further notice, meetings will be held every Sunday afternoon, from about 2.30, at Kenton Grange. Members of other Clubs, and other visitors, will be welcomed, and are requested to bring their models with them.

Hon. Sec.: A. D. POLE, 13, Churchfield Close, North Harrow, Middlesex.

Altrincham Model Power Boat Club

A hydraulic ram has been installed to maintain the water-level in the lake. The next meeting is on Thursday, May 1st, at 8 p.m., at the following address.

Hon. Sec.: O. B. BATES, 2, Hereford Villas, Hereford Street, Sale.

Edinburgh Society of Model Engineers

At the February monthly meeting, our old friend, Andrew Todd, of Glasgow, gave us an extremely interesting talk on his 5-in. gauge 0-4-0 works locomotive, a description of which formed the subject of an illustrated article in THE MODEL ENGINEER recently. His talk was followed with keen interest and due note was taken of the many original methods of setting up and machining the various items. Questions abounded and were all dealt with at considerable length.

At the March meeting, Mr. L. A. Wilde gave an excellent talk on Electric Timekeeping. With the assistance of a series of lantern slides which he had prepared, Mr. Wilde gave a comprehensive review of the various systems in use, indicating their respective merits and defects. In response to a question, he described types of mains clocks and an interesting and lengthy discussion ensued.

The Parts in Progress meeting, scheduled for Saturday, May 31st, will conclude the present session of talks, etc., and during the summer months the Workshop and Club Room at 1A, Ramsay Lane, Castle Hill, will continue to be open on Saturdays at 3 p.m., and on Tuesdays at 8 p.m.

Hon. Sec.: H. V. PRESCOTT, 8, Russell Place, Edinburgh 5.

Hull Society of Model Engineers

The next meeting of the above Society will be held again at Mr. S. Smithson's, 99, Derringham Street, at 10 a.m., on Sunday, May 4th.

The Society is at all times delighted to welcome new members, and anyone in the district interested in model or small power engineering of any kind should not hesitate to come along any Sunday morning. They can be certain of finding a warm welcome and many new and lasting friends.

Hon. Secretary: E. BELLAMY, 49, Wold Road, Hull.

The Leeds Model Railway and Engineering Society

On April 20th several models were seen running under steam; our old stand-by, Mr. Cook, brought another one out of the bag. A fine model of "Miss Ten-to-eight," made by Mr. Hollins, was very much admired. Our next meeting will be held on May 4, when a track meeting will be held.

Meeting place: F. Cook, Kidacre Street, Leeds.

Hon. Sec.: H. E. STAINTHORPE, 151, Ring Road, Farnley, Leeds.

York and District Society of Model Engineers

The next meeting will be held on Friday, May 2nd, 7.30 p.m., at 26, Longfield Terrace, York.

Hon. Sec., *pro tem.*: H. P. JACKSON, 26, Longfield Terrace, York.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks. Annual Subscription, £1 10s., post free, to all parts of the world

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Cordwallis Road, Maidenhead. Berks.